They appear from these observations to distinguish the difference between the temperature of the water where they assume the normal forward course and the point where they give the avoiding reaction. This difference within the range of temperatures compatible with the life of the animal is probably some tenths of a degree, varying with the immediate antecedent experience of the individual.

The method of graphing has been found very useful in making accurate determinations of reaction where modification by environment has been attempted and where accurate determination of sensibility is necessary. One has only to take readings from a graph like number 3, make statistical records, and compute percentages in the thirds, repeating the readings, at ½ min., 1-min. and 2-min., intervals, beginning after ½, 1, 2 minutes, etc., after the graph began to demonstrate that percentage in the thirds, with short intervals at least, is a very unreliable method of making records, unless the reading is done with absolute precision.

The occurrence of the rapid modification of behavior described in practically all the great groups of the animal kingdom leads one to attempt to explain the phenomenon on the basis of some physiological characteristic common to all. In connection with the study of fishes the writer and Allen[14] suggested that in both the case of carbondioxide and lack of oxygen in water the increased irritability is due to increased acidity. In support of this we cited Waller who found that a small amount of carbondioxide increases irritability of nerves.

A similar explanation of the shorter invasions of light in a light gradient in which the Daphnias turn back in a lower intensity as described by Davenport and Cannon, was offered by Loeb[15] who anticipated our conclusion, independently derived, and cited Waller though he attributed the development of acidity to the increased metabolism of the organism due to the stimulation.

Since the phenomenon of modification under consideration takes place in gradients of ammonia in alkaline water, and the fishes concerned are positive to the ammonia, and since such behavior has been noted in the avoidance of cold, darkness, etc., which depress metabolism, thus the hypothesis of increased irritability due to acidity can be maintained only on the assumption that all changes in the environment stimulate the metabolism temporarily. This is not out of accord with the effects of depressing drugs which nearly all stimulate first, for a short time, and then depress.

Whatever may be the correct physiological explanation of the phenomenon, we have noted that the process is similar in the mammal and in the Protozoan. The reactions of both are such as to suggest learning, that is, the possible association of increasing stimulation with stronger stimulation farther on in the course being pursued, though it is hardly to be expected in the Protozoan. If the most intelligent animal behaves like the simplest Protozoan and if pleasure and pain are the basis for intelligence, an analysis of this type of modification may yield data showing that the modification is not essentially different from associative memory. The graphs appear to be but a general statement of the gagging of the chick at the sight of a distasteful species of caterpillar which it has tried on an earlier occasion.

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[14] Shelford and Allee, *Jour. An. Beh.*, Vol. IV., p. 7. Shelford, *Jour. An. Beh.*, Vol. IV., p. 31.

[15] Loeb, "Mechanistic Conception of Life," p. 222.

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